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Agricultural Memorandum No 809

ASSESSMENT OF THE 'EXPOSURE' OF PASTURES

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Summary

As part of a survey into lamb mortality prior to weaning, carried out at Bradfield Farm, Reading, Berkshire in co-operation with the veterinary advisory unit of South-east ADAS, an attempt was made to assess the 'exposure' of a number of pastures using standard meteorological equipment. An important aspect of this study was that it should provide information of aid to the farm manager in planning the allocation among the fields of the inherently weaker twin and triplet lambs

Introduction

' . . . there is hardly an expense equal to the effects, both to fields and (livestock), of a gnawing or destroying air'

Bain (Quart. Jour. Agric ~1839)

Farm livestock can be affected by climate both indirectly in its influence upon the availability of food and directly as a result of exposure to climatic rigours (Blaxter 1962, Obst and Day 1968, Hugh-Jones, 1976, Sykes et al 1976 etc). However, grazing stock are not entirely at the mercy of their environment; their mobility means that shelter may be sought (Michael 1960) and the influence of the close community of the flock may ameliorate the micro-climate for the individual animal.

The enforced use of shelter by ewes and lambs has been noted (Egan et al 1972) to be a major contributory factor in reducing neo-natal lamb deaths; indeed Cresswell and Thomson (1964) found that even the small amount of shelter afforded by 'tussocky' pasture could be important for lambs.

Qualitative estimates of the efficacy of geomorphic shelter can be deduced from the daily grazing patterns of flocks in response to different wind and temperature regimes (Munro, 1962).

In field studies designed to evaluate the effect of meteorological factors on

livestock long-term interdisciplinary studies are desirable. Often, however, an agriculturalist will require a swift assessment of a problem which is having, or could have, important economic consequences for him.

Logistically, too, there are the problems of supervising and maintaining site equipment and of monitoring data regularly (Smith 1970). Changes from year to year in grazing facilities, husbandry techniques etc., add further dimensions of difficulty. However, it was Gloyne's (1963) conviction that, given a sufficiency of frequent data, it should be possible to infer the basic features of at least the wind regime at any site in periods reckoned in days and weeks rather than months or years; it was this philosophy that was adopted in the Bradfield meteorological survey.

Establishment of field equipment

Ewes and their lambs were to be allocated to four fields on a south-facing, undulating slope of the Berkshire Downs leading down to the River Pang (fig. 1).

The establishment of a network of instruments around the fields was guided by the limitations imposed by the number and nature of the instruments, the necessity of maintaining sites and collecting data and the availability of staff. Data was to be related to a 'reference' station established in Annis Field .

Initially three 'run-of-wind' cup counters (exposed at 2m height) and seven 'Cocoa-tin' minimum thermometers (Hurst 1970) (exposed at 1m height) were established at 'key' points: that is, near feed and watering areas , 'night camps' and significant hollows (fig. 1). Information from farm staff on these matters was vital in the selection of sites . Wind surveys with a hand-held cup-counter helped to establish a 'feel' for the airflow in each field under a variety of wind directions (spot wind direction information could be obtained from the indicators on each cup-counter; in the longer term direction data from a nearby meteorological station were used).

Data were gathered from late January 1976, (soon after the survey was proposed) for a period of 6 months; during the critical 6-week post-natal period daily readings were taken. Towards lambing time (late March) the initial data

were studied with a view to offering guidance as to lamb placement.

Data survey

The initial anemometer data are presented in Table 1. Average wind speeds (over 3 or 4 days) are expressed as a percentage of those at the Annis Field reference station. Data are summarised in the 'exposure roses' (fig. 2). Although based on only 15 cup anemometer readings over 6 or 7 weeks the 'roses' highlight the highly exposed nature of the feeding area in Rushall Field to the prevailing winds from the south-west quadrant.

Although Annis Cross 2 was situated on a ridge and some 30m higher than the Rushall feed area, it presented a comparatively sheltered character for most wind directions. Minimum temperature readings (table 2) showed the comparative severity of the 'frost hollow' potential in Rushall. The two lowest temperatures recorded at 1m height (-7.1, -6.6°C) were more than 1°C below the corresponding values recorded in the Annis Field hollow (H) and some 2°C below those recorded in Annis Cross 2.

The available data suggested, therefore, that Rushall field presented the greatest exposure hazard for livestock and that the potentially weakest (triplet) lambs should be placed in Annis Cross 2.

Sequel

It was hoped to begin to establish a relationship between lamb mortality and meteorological 'exposure' on at least a qualitative basis. However, ewes were in an excellent condition following a mild winter and ideal weather brought a bumper lamb crop. Of some 700 lambs born (120 singles, 500 twins, 80 triplets) only 19 were recorded as field losses. All but two of these were single lambs in Rushall; one of the triplets succumbed in Annis Cross 2. This statistic, perhaps, justifies the exposure ratings deduced; it should be borne in mind, however, that mis-mothering by the gimmers in the large (20 hectares) Rushall Field might well have contributed to the mortality figures, weather playing a secondary role.

Wind data gathered to the end of June (fig 3) confirm the initial 'exposure roses'. A graphical summary of the average wind speeds at different sites as a function of direction is presented in fig 4.

Subsequently the cup-counter network was extended to the hollows in Annis (H) and Rushall (L) fields (fig 1). Several interesting features of the airflow were noted: under a westerly flow wind speeds in H were some 20% more than at the reference site 16m higher; a northerly or southerly wind of up to 3 m/s caused a reverse direction flow at H. Topography and tree configuration similarly increased the airflow at L under a southerly or northerly flow over that at K; such influences of various features of the landscape on airflow have been remarked on by Gloyne (1976), Hogg (1964-65) and others.

A survey of minimum temperatures on radiation nights between February and May which resulted in air frost (some 15 occasions) gave the results presented in table 3; the relative merits of the various fields from the 'frost potential' point of view are confirmed.

Summary

Data show that substantial variations in wind speed (and frost potential) can occur even between one field and the next; higher ground is not necessarily more 'exposed', nor low lying areas more sheltered. Above all the survey demonstrates the potential of assessing the 'exposure' of pastures. Agriculturalists could use the data in choosing feeding sites, in allocating weakling stock and, in longer term, in assessing the need for establishing shelter belts.

Any comments or suggestions on this paper should be referred to the author.

Meteorological Office
Bracknell

September 1976

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Tables: Legend.

1. Initial wind data.

2. 'Cocoa-Tin' Minimum temperature data.
   Refer to fig. 1 for instrument siting.

3. Average differences (ΔT) between minimum temperatures on radiation nights at sites H, J, K and L and those at reference site G.

Table 1 Initial Wind Data

Date	Wind speed - averaged over 3 or 4 days at Annis Field reference station m/s	Average wind speed in terms of that at reference station Annis Cross 2 Rushall %		Average wind direction 0-44° → 1, 045-089° → 2, 315-359° → 8
January 26	3.0	72	69	2
30	3.3	59	58	3
February 2	2.8	60	62	2
6	1.2	78	107	4
9	2.9	92	157	6
13	2.0	66	82	2
16	1.3	57	70	3
20	1.6	80	126	4
23	1.2	100	178	5
27	1.5	-	193	5
March 1	1.5	-	65	2
5	3.0	43	54	3
8	1.5	69	110	4
12	2.2	59	78	3
15	1.6	61	81	1
19				

Table 2 'Cocoa-Tin' Minimum Temperature Data

Temperatures in °C - Minima over 3 or 4 days

Date		Annis Field G	Annis Field H	Annis Cross 2 J	Rushall K	Rushall L	Screen Minimum (Annis Field) G
January	26						
		- 5.3	- 6.2				
	30						
		- 2.7	- 2.5	- 2.9	- 2.7		- 2.7
February	2						
		- 2.1	- 2.0	- 2.3	- 2.0		- 2.0
	6						
		- 3.1	- 3.6	- 2.7	- 2.6		- 2.5
	9						
		1.4	1.1	0.6	1.5	1.1	1.4
	13						
		- 1.5	- 1.6	- 1.5	- 1.5	- 1.5	- 1.0
	16						
		3.1	- 0.9 (?)	0.1	- 0.1	- 0.2	0.3
	20						
		-	3.4	4.0	4.5	4.4	4.6
	23						
		-	3.0	3.4	5.0	3.1	5.0
	27						
		- 1.9	- 2.9	- 1.5	- 2.2	- 3.1	- 1.3
March	1						
		- 4.2	- 5.4	- 3.5	- 5.9	- 6.6	- 3.7
	5						
		- 2.5	- 4.2	- 2.7	- 3.0	- 3.9	- 2.1
	8						
		- 4.3	- 6.0	- 4.6	- 5.3	- 7.1	- 3.8
	12						
		0.3	- 1.4	0.8	0.0	0.2	0.9
	15						
		- 1.3	- 1.1	- 1.6	- 1.6	- 1.3	- 1.0
	19						

Table 3.

SITE	G	H	J	K	L
ΔT °C	0	-1.5	+0.5	-1.0	-2.1
Standard deviation ($\pm$)	-	0.9	0.5	0.7	0.8

(A negative value signifies a site minimum below that at G. The relationship between 'cocoa-tin ' and screen minima, (T_c and T_s respectively) at G was found to be:

$$T_c = T_s - 0.5 \text{ (standard deviation } \pm 0.2) \text{ in } ^{o}C$$

Figures **Legend**

1. Map of Bradfield Farm:

Instrument sites are lettered G,H,J, K and L, G being the reference site housing: Stevenson Screen, 'cocoa-tin' and grass minimum thermometers, recording and digital cup-counters, 5" rain-gauge. At other sites the symbols O and X represent cocoa-tin minimum thermometers and cup-counters respectively.

Four contours are shown: 60,75,90 and 105 metres (about 200 to 350 feet)

2. Initial 'exposure roses' based on 7 weeks data

3. 'Exposure roses' based on a further 4 months data

4. Wind speed as a function of direction at Rushall and Annis Cross 2 referred to the Annis Field site values. See table 1 for key to wind direction. Ringed 'directions' refer to Rushall field.

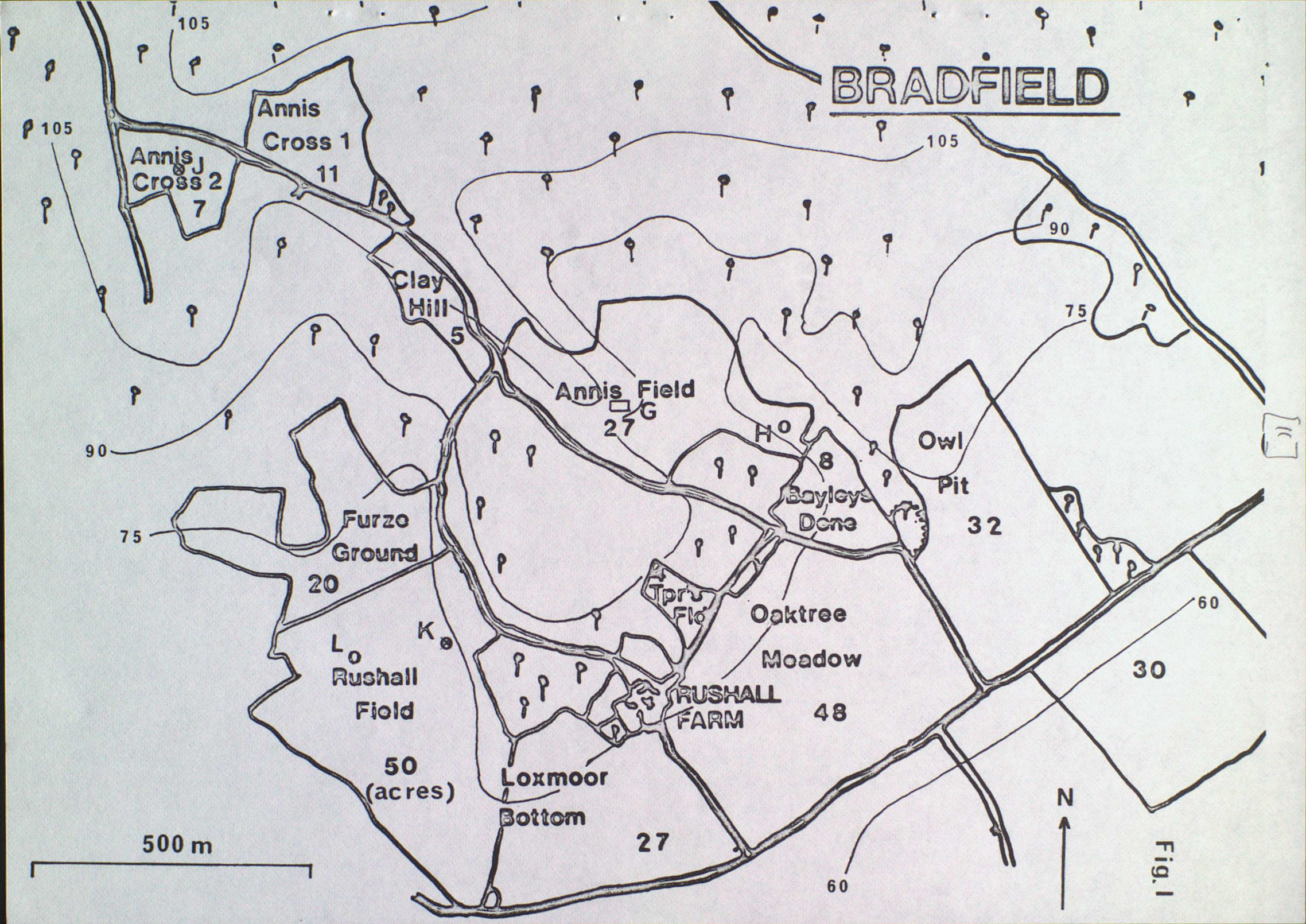

BRADFIELD
105
Annis Cross 1
11
Annis Cross 2
7
Clay Hill
5
Annis Field
27
G
H
8
Bayleys Done
Owl Pit
32
90
75
Furze Ground
20
K
L
Rushall Field
50 (acres)
Tpr
Fld
Oaktree Moadow
RUSHALL FARM
48
Loxmoor Bottom
27
30
60
500 m
N
Fig. I

Fig 2

'Exposure roses' based on initial 7 weeks data

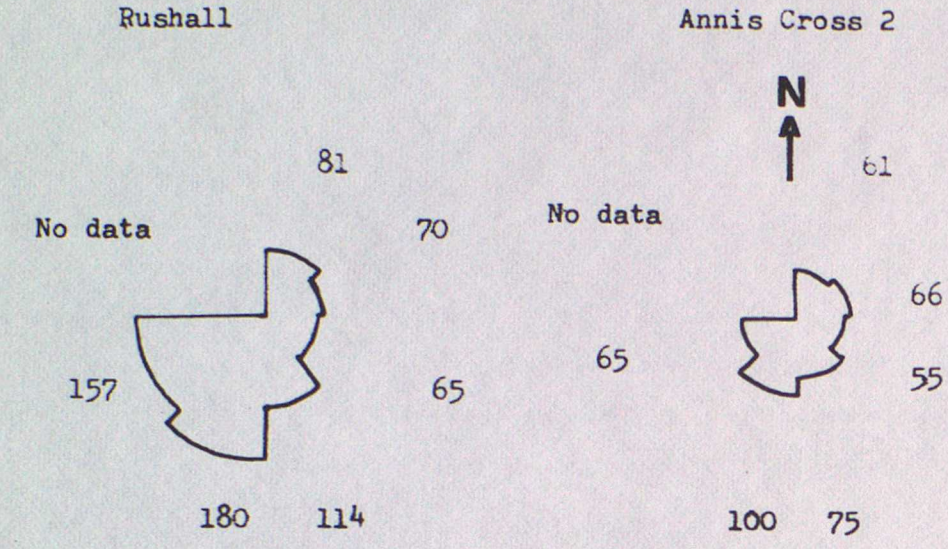
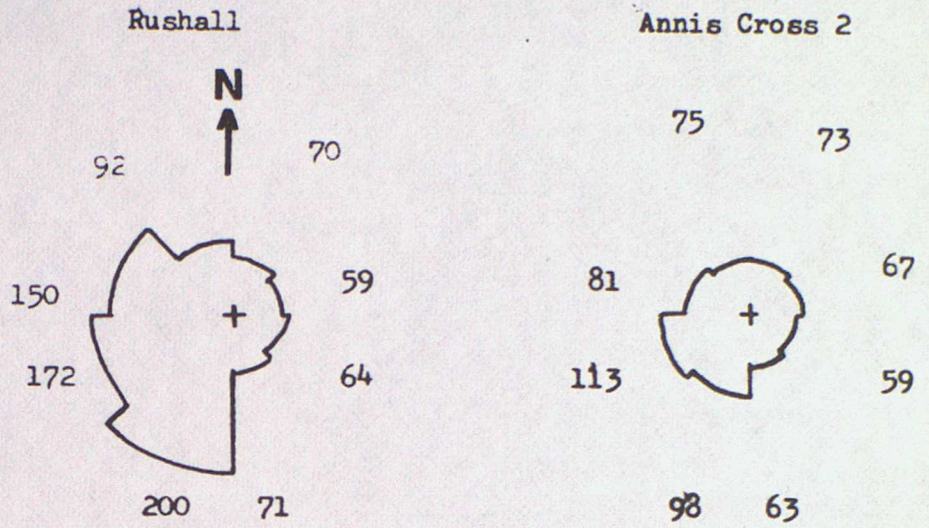


Fig 3

'Exposure roses' bases on further 4 months data



[12]

Ratio, expressed as percentage, of wind speed in field to wind from corresponding direction at the reference site in Annis Field i.e. in Rushall, wind speeds from south to south-west are a factor of two up on those in Annis Field (and Annis Cross 2).

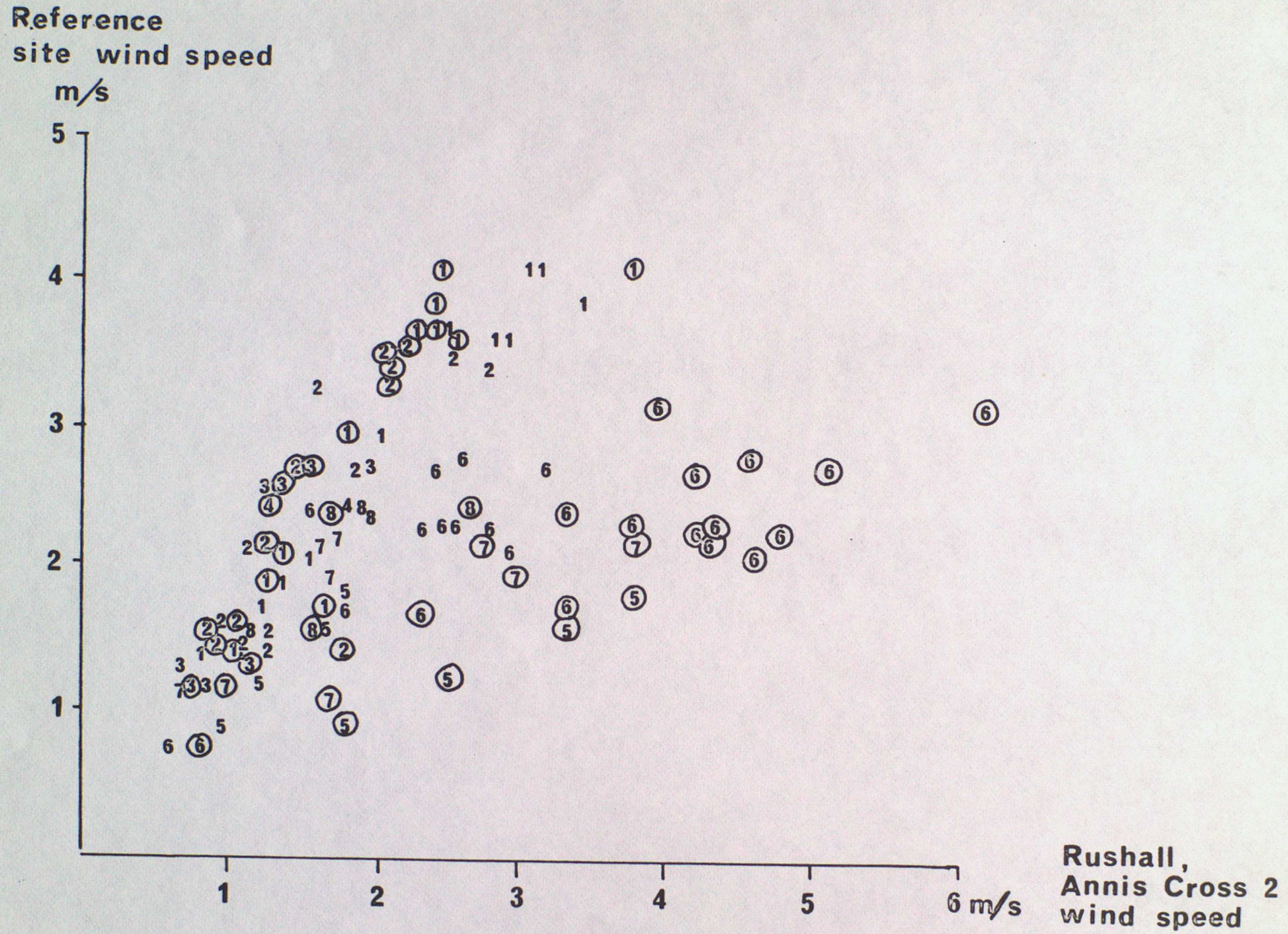

Reference
site wind speed
m/s
5
4
3
2
1
1
2
3
4
5
6 m/s
Rushall,
Annis Cross 2
wind speed

Fig.4

[13]